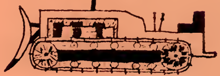
LOGAN CREEK WATER QUALITY STUDY



WATER QUALITY BUREAU

Environmental Sciences Division

Montana Department of Health and Environmental Sciences

1977

Technical Report

LOGAN CREEK WATER QUALITY STUDY
FISCAL YEAR 1977 REPORT

Submitted To:

U.S.D.A. FOREST SERVICE
FOREST SUPERVISOR
Flathead National Forest
Kalispell, Montana
59901

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Kalispell Regional Office

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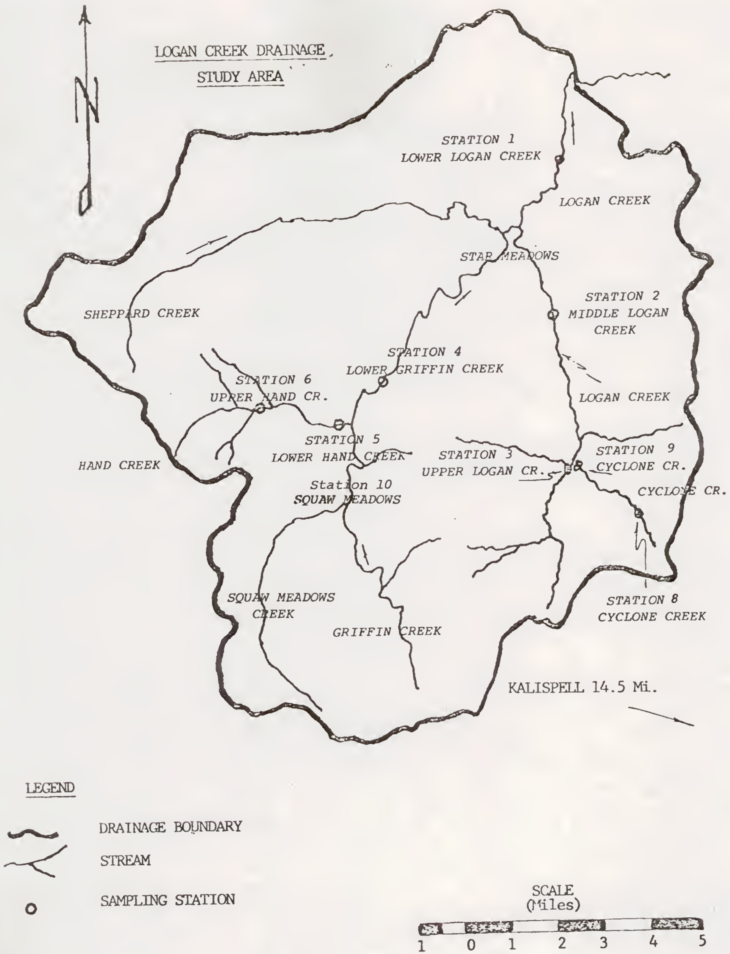
INTRODUCTION

The attached report was prepared by the Montana Department of Health and Environmental Sciences under contract to the Flathead National Forest during fiscal year 1977. It represents a continuation of the study which was undertaken in 1975 and which is published in technical reports 75-2 and 1976 prepared by the Montana Water Quality Bureau.

Sample collection and field analyses were accomplished by the Kalispell Regional Office of the Montana Department of Health and Environmental Sciences, principally in the person of Mr. Geoffrey Hughes, Water Quality Specialist, with assistance by other members of the regional office staff. Many of the chemical analyses were carried out by the Department's chemistry laboratory in Helena.

The study area is located on the Tally Lake Ranger District of the Flathead National Forest. The drainage is the same as that which was described in technical report 75-2. Sampling at the Lower Logan Creek and Griffin Creek locations was discontinued during 1976 in favor of more suitable locations. One such location was Station #9, Lower Cyclone Creek which had been used briefly during fiscal year 1976.


LOGAN CREEK DRAINAGE
STUDY AREA
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STATION 1
LOWER LOGAN CREEK
LOGAN CREEK
STAR MEADOWS
SHEPPARD CREEK
STATION 2
MIDDLE LOGAN
CREEK
STATION 4
LOWER GRIFFIN CREEK
STATION 6
UPPER HAND CR.
LOGAN CREEK
STATION 5
LOWER HAND CREEK
STATION 3
UPPER LOGAN CR.
STATION 9
CYCLONE CR.
HAND CREEK
Station 10
SQUAW MEADOWS
CYCLONE CR.
SQUAW MEADOWS
CREEK
GRIFFIN CREEK
STATION 8
CYCLONE CREEK
KALISPELL 14.5 Mi.
LEGEND
DRAINAGE BOUNDARY
STREAM
SAMPLING STATION
SCALE
(Miles)
1 0 1 2 3 4 5

THE SAMPLING NETWORK

The sampling stations were the same throughout the test period as those described in the previous reports. In connection with the recommendations of the 1976 report, sampling was discontinued at Stations #1 and #4. This allowed for full time sampling at both Stations #8 and #9, above and below the proposed Cyclone Creek activity. Another location has been selected on Squaw Meadows Creek and will be added during fiscal year 1978.

COMMENTS ON DATA COLLECTION AND SAMPLING FREQUENCY

Maintenance of the thermographs continued to be a problem, as reflected by the gaps in this data. Because of this maintenance problem and the limited use of the thermographs on the project, they might be put to better use elsewhere on the forest where district personnel have the opportunity to collect the record throughout the year and provide adequate maintenance.

Budget limitations during fiscal year 1977 necessitated a reduction to 6 samples per station. These were scheduled so that 4 would be taken during the spring runoff and the remaining 2 following hydrologic events. (Both September samples were collected on the heels of a rain storm).

At the time of the first sampling trip, May 10, 1977; Station #8 was inaccessible.

At the time of the September trips, there was no detectable flow at Staion #9 Cyclone Creek goes underground in this area, and during dry periods it cannot be sampled. As a result there are missing entries in the data for these samples.

As the result of an apparent communication problem, the laboratory did not run potassium analyses on the spring samples. This parameter was included in the fall analyses and will be included routinely in FY 1978 analyses.

PART I

PHYSICAL AND CHEMICAL ASSESSMENT

General Comments

Snowfall in the study area during the winter of 1976-77 was far below normal. As a result, flow measurements were considerably below those measured in the spring and summer of 1976. For example, the maximum recorded flow at Station #2, Middle Logan Creek was 21 cfs on May 26, 1977. Examination of the flow data collected at this location during 1976 reveals that the flow was consistently in excess of this value well into August; and that the maximum recorded value was 130 cfs (a sixfold increase) on May 13, 1976. As a result of this markedly reduced flow, the changes in water quality normally associated with spring runoff were not observed in the spring of 1977.

Hand Creek Stations 5 and 6

These locations continue to provide the best location to monitor water quality in recently harvested drainages. In view of the low flows, one would expect corresponding low values of turbidity and suspended sediment. This was indeed the case, except for the seemingly anomalous values recorded at Station #5 on May 10.

Organic color continues to run high in Hand Creek. The 1976 data reflected some significant increases over the 1975 data. The current year's data are considerably lower than last year. However, comparison of the 1977 data with periods of corresponding flow during 1975 suggests that the concentration of this parameter is still elevated.

pH, alkalinity and specific conductance data are essentially unchanged from previous years and are typical of streams in predominantly quartzite drainages. No peculiarities were noted in nutrients, bed load or the chemical constituents examined.

Middle and Upper Logan Creek Stations 2 and 3

Comparison of the data from these stations with periods of approximately equivalent flow during 1976 shows little or no change. Total suspended sediment was not detected at either location. The values for turbidity and organic color, which are viewed as indications of silvicultural impact are essentially unchanged.

pH, total alkalinity and specific conductance measured at these locations are characteristic of the geology of the drainage. Measurable bed load was found on only on occasion. The concentrations of nutrients and chemical parameters examined were unremarkable.

Cyclone Creek Stations 8 and 9

Once again, low flows at Staion #9 precluded the use of the DH-48 sampler. Grab samples were collected at this location.

Construction of roads in this area has not yet been undertaken, so little change would be expected in the water quality of Cyclone Creek. This is indeed the case. Comparison of the 1977 data with that from 1976 reflects little or no change in concentration of any of the parameters examined. It is anticipated that new roads will be undertaken in the Cyclone Creek drainage during 1978, and the effect of this activity can be determined over the next two or three years.

Conclusions Based on Data

In view of the low flows during the sampling period, any generalizations based on 1977 data would be poorly founded. Nevertheless, comparision of the data of Appendix I with data obtained during equivalent flow periods of previous years suggests certain conclusions:

(1) The time required for water quality to return to normal following logging in the drainage is in the order of 4 years, under favorable conditions.

(2) Organic color is the parameter which remains elevated longest, even when changes in suspended sediment and turbidity can no longer be detected.

Suggestions for Continued Monitoring

To further test the conclusions made in this and previous reports, sampling should be continued on these streams. Further sampling on Hand Creek should show how long it takes for the organic color to return to natural conditions. Efforts should be concentrated in areas where new activities will be undertaken, such as the Upper Logan-Cyclone Creek area.

APPENDIX I

PHYSICAL AND CHEMICAL DATA

Flow (CFS)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 Middle Logan Cr.	10	21	17	15	8	9.5
#3 Upper Logan Cr.	2.8	2.5	2	2	1	1
#5 Lower Hand Cr.	10	12	10	7	3	3
#6 Upper Hand Cr.	6.5	1.5	1	1	1	1.5
#8 Upper Cyclone Cr.	---	1.0	1	1	1	1
#9 Lower Cyclone Cr.	< 1	< 1	< 1	< 1	< 1	< 1

Gauge Height (ft.)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 Middle Logan Cr.	0.96	0.90	0.87	0.84	0.78	0.80
#3 Upper Logan Cr.	0.46	0.47	0.36	0.34	---	0.30
#5 Lower Hand Cr.	1.60	1.49	1.22	1.14	0.94	0.94
#6 Upper Hand Cr.	1.18	0.90	0.74	0.70	0.90	0.90
#8 Upper Cyclone Cr.	---	1.40	1.20	1.16	1.16	1.16
#9 Lower Cyclone Cr.	---	---	---	---	---	---

Turbidity (JTU)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 iddle Logan Cr.	0.5	0.3	0.2	0.2	0.1	0.4
#3 pper Logan Cr.	0.7	0.2	0.2	0.1	0.3	0.6
#5 ower Hand Cr.	3.5	0.4	1.3	0.2	0.2	0.3
#6 pper Hand Cr.	0.5	0.2	0.3	0.3	0.2	0.4
#8 pper Cyclone Cr.	---	0.4	0.4	0.2	0.4	0.4
#9 ower Cyclone Cr.	0.9	0.4	0.8	0.5	---	---

Total Suspended Sediment (mg/1)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 iddle Logan Cr.	0	0	0	0	0	0
#3 pper Logan Cr.	0	0	0	0	0	0
#5 ower Hand Cr.	3	0	2	0	0	0
#6 pper Hand Cr.	0	0	0	0	0	0
#8 pper Cyclone Cr.	---	0	0	0	0	0
#9 ower Cyclone Cr.	0	0	0	0	---	---

Organic Color (Pt/Co Units)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 ddle Logan Cr.	5	5	5	0	0	0
#3 per Logan Cr.	15	10	5	5	0	0
#5 wer Hand Cr.	35	25	20	20	0	0
#6 per Hand Cr.	25	30	20	15	0	0
#8 er Cyclone Cr.	---	5	0	0	0	0
#9 wer Cyclone Cr.	10	0	0	0	---	---

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 dle Logan Cr.						
#3 er Logan Cr.						
#5 er Hand Cr.						
#6 per Hand Cr.						
#8 er Cyclone Cr.						
#9 er Cyclone Cr.						

Bed Load (oz.)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 iddle Logan Cr.	0.5	0	0	0	0	0
#3 pper Logan Cr.	0	0	0	0	0	0
#5 wer Hand Cr.	1	0	0	0	0	0
#6 pper Hand Cr.	0	0	0	0	0	0
#8 pper Cyclone Cr.		0	0	0	0	0
#9 wer Cyclone Cr.	0	0	0	0		

Specific Conductance (μmhos/cm)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 ddle Logan Cr.	350	345	350	350	360	350
#3 per Logan Cr.	292	300	320	330	330	330
#5 wer Hand Cr.	51	48	45	45	48	45
#6 per Hand Cr.	33	33	30	35	40	41
#8 per Cyclone Cr.	---	360	360	350	355	355
#9 wer Cyclone Cr.	345	360	340	350		

pH

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 iddle Logan Cr.	7.97	8.01	8.00	7.97	8.01	7.99
#3 pper Logan Cr.	7.90	7.93	8.02	8.06	8.03	8.00
#5 ower Hand Cr.	6.99	7.03	6.98	6.99	7.01	7.06
#6 per Hand Cr.	6.51	6.85	6.63	6.44	6.55	6.79
#8 per Cyclone Cr.	---	8.06	8.11	8.17	8.20	8.20
#9 ower Cyclone Cr.	8.00	8.18	8.20	8.12	---	---

Total Alkalinity

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 ddle Logan Cr.	152	154	170	172	188	185
#3 per Logan Cr.	117	125	139	144	161	155
#5 wer Hand Cr.	16	16	23	25	40	33
#6 er Hand Cr.	12	11	15	16	20	20
#8 r Cyclone Cr.	---	176	180	163	169	170
#9 r Cyclone Cr.	178	186	197	185		

Calcium (mg/1)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 iddle Logan Cr.	45.7	47.3	47.3	49.3	55.0	51.0
#3 pper Logan Cr.	36.1	40.1	42.5	42.9	49.0	46.0
#5 ower Hand Cr.	6.0	4.8	6.4	5.6	10.0	7.5
#6 pper Hand Cr.	2.4	4.0	2.4	2.4	6.5	4.5
#8 pper Cyclone Cr.	---	51.0	54.0	54.0	51.0	50.0
#9 ower Cyclone Cr.	51.0	53.0	58.0	56.0	---	---

Magnesium (mg/1)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 iddle Logan Cr.	9.2	9.7	12.1	10.4	11.0	13.5
#3 pper Logan Cr.	6.8	7.0	7.8	8.5	9.4	11.0
#5 ower Hand Cr.	0.2	1.2	1.5	1.7	5.6	5.6
#6 pper Hand Cr.	0.7	0.5	1.5	0.7	1.9	4.4
#8 pper Cyclone Cr.	---	10.2	9.7	9.2	11.5	12.0
#9 wer Cyclone Cr.	12.4	12.8	13.1	12.0	---	---

Sodium (mg/1)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 ddle Logan Cr.	2.2	2.2	2.3	2.3	2.6	2.5
#3 er Logan Cr.	1.9	1.7	1.8	1.8	2.0	1.9
#5 wer Hand Cr.	2.4	2.7	3.1	3.1	4.2	4.2
#6 per Hand Cr.	2.1	2.2	2.5	2.5	3.8	3.8
#8 per Cyclone Cr.	---	1.7	1.7	1.7	1.8	1.8
#9 wer Cyclone Cr.	2.1	2.2	2.3	2.3	---	---

Potassium (mg/1)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 dle Logan Cr.					2.4	2.2
#3 er Logan Cr.					2.3	2.1
#5 er Hand Cr.					2.1	1.9
#6 er Hand Cr.					2.0	1.7
#8 Cyclone Cr.					2.4	2.3
#9 Cyclone Cr.					---	---

Chloride (mg/1)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 Middle Logan Cr.	0.1	0.2	0.1	0.2	1.7	2.6
#3 Upper Logan Cr.	0.1	0.1	0.5	0.1	1.7	1.8
#5 Lower Hand Cr.	0.3	0.2	0.2	0.2	1.7	1.8
#6 Upper Hand Cr.	0.5	0.6	0.2	0.3	1.7	1.9
#8 Upper Cyclone Cr.	---	0.2	0.1	0.1	2.4	1.8
#9 Lower Cyclone Cr.	0.2	0.1	0.6	0.5	---	---

Sulfate (mg/1)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 Middle Logan Cr.	4.0	3.8	3.6	3.4	2.7	9.4
#3 Upper Logan Cr.	5.5	3.7	3.9	3.9	10.4	10.0
#5 Lower Hand Cr.	3.8	3.4	3.3	3.3	10.6	10.8
#6 Upper Hand Cr.	3.6	3.2	3.1	2.9	5.0	9.0
#8 Upper Cyclone Cr.	---	2.8	2.8	6.3	11.7	12.4
#9 Lower Cyclone Cr.	4.4	4.0	7.2	4.0	---	---

Nitrate + Nitrite (mg/1 as N)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 ddle Logan Cr.	0.05	0.02	0.02	0.02	0.01	0.01
#3 er Logan Cr.	0.09	0.04	0.04	0.04	0.01	0.01
#5 wer Hand Cr.	0.08	0.01	0.01	0.01	0.01	0.01
#6 per Hand Cr.	0.01	0.02	0.01	0.03	0.01	0.01
#8 er Cyclone Cr.	---	0.05	0.05	0.06	0.02	0.02
#9 wer Cyclone Cr.	0.17	0.08	0.08	0.09	---	---

0-Phosphate (mg/1)

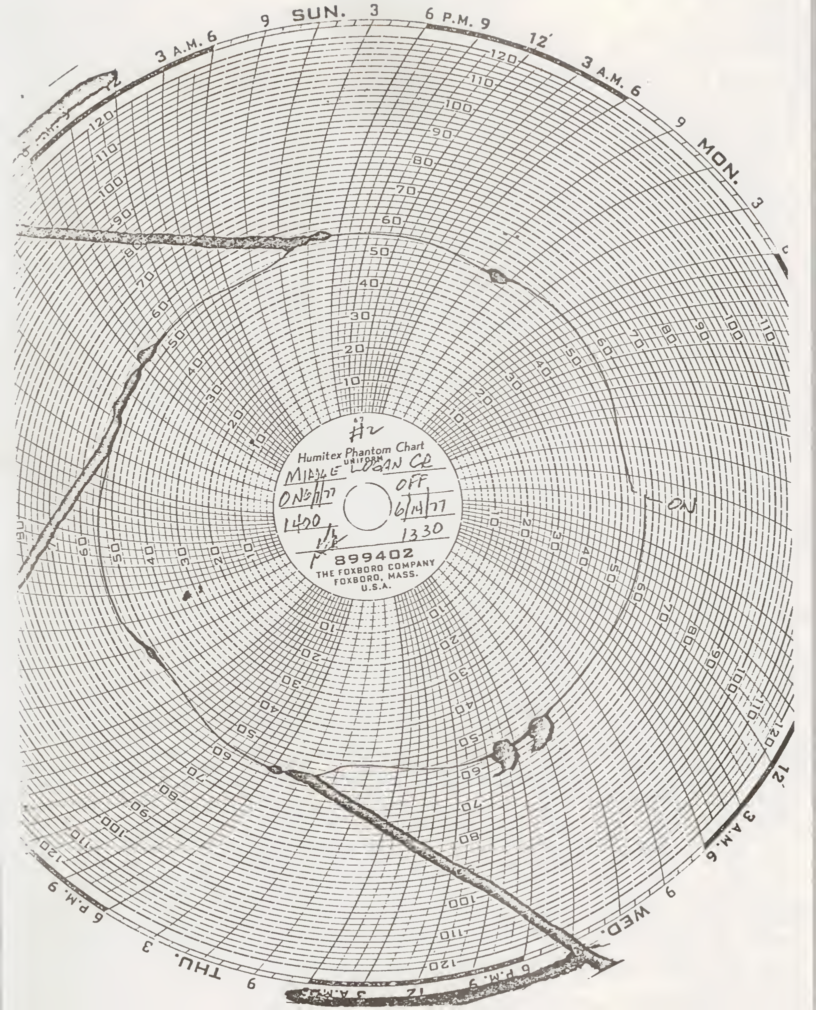
	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 dle Logan Cr.	< 0.001	0.001	0.001	<0.001	<0.001	0.002
#3 r Logan Cr.	<0.001	<0.001	<0.001	<0.001	0.001	0.001
#5 r Hand Cr.	< 0.001	<0.001	0.001	<0.001	<0.001	0.001
#6 r Hand Cr.	<0.001	<0.001	<0.001	0.002	0.005	0.001
#8 Cyclone Cr.	---	<0.001	<0.001	0.003	0.001	0.001
#9 Cyclone Cr.	<0.001	<0.001	<0.001	0.002	---	---

Air Temperature (°F)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 iddle Logan Cr.	58	58	71	62	50	44
#3 pper Logan Cr.	61	60	72	64	50	46
#5 ower Hand Cr.	61	61	70	70	45	51
#6 pper Hand Cr.	57	59	66	67	44	49
#8 pper Cyclone Cr.	55	60	71	68	49	43
#9 ower Cyclone Cr.	55	60	68	66	50	45

Water Temperature (°F)

	5/10/77	5/26/77	6/7/77	6/14/77	9/20/77	9/29/77
#2 iddle Logan Cr.	42	44	46	48	46	40
#3 pper Logan Cr.	40	42	43	45	48	38
#5 ower Hand Cr.	42	45	50	50	45	38
#6 pper Hand Cr.	43	44	46	48	45	37
#8 pper Cyclone Cr.	43	45	48	56	46	37
#9 ower Cyclone Cr.	42	45	46	51	---	---



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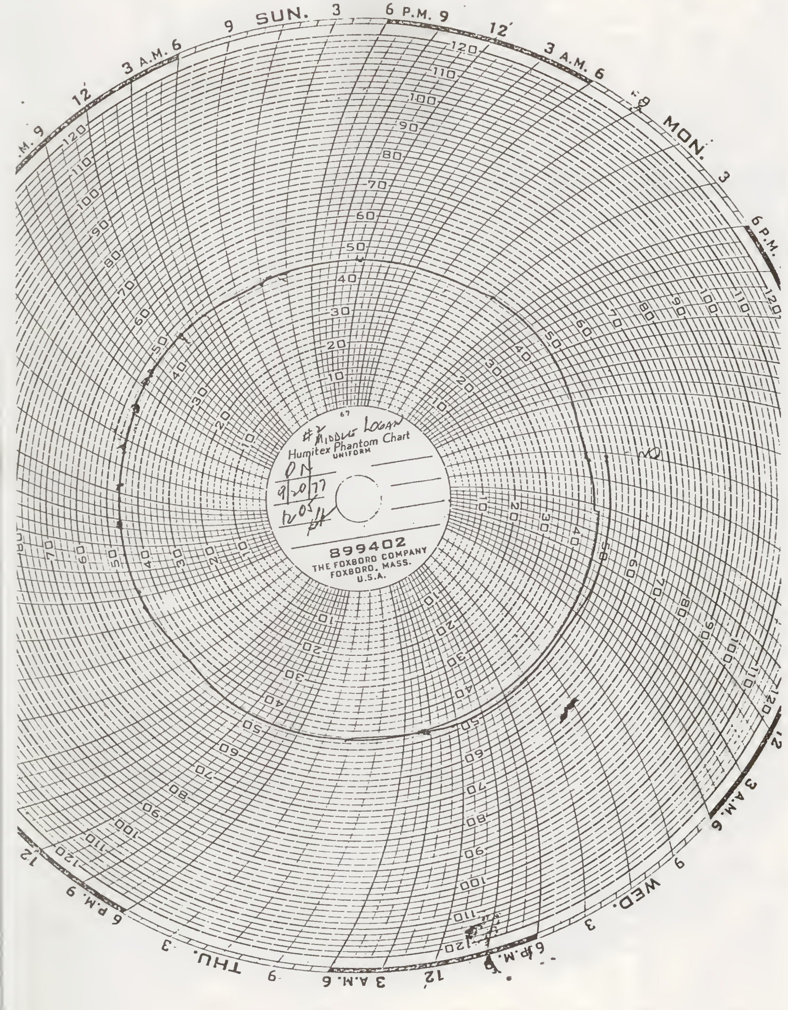

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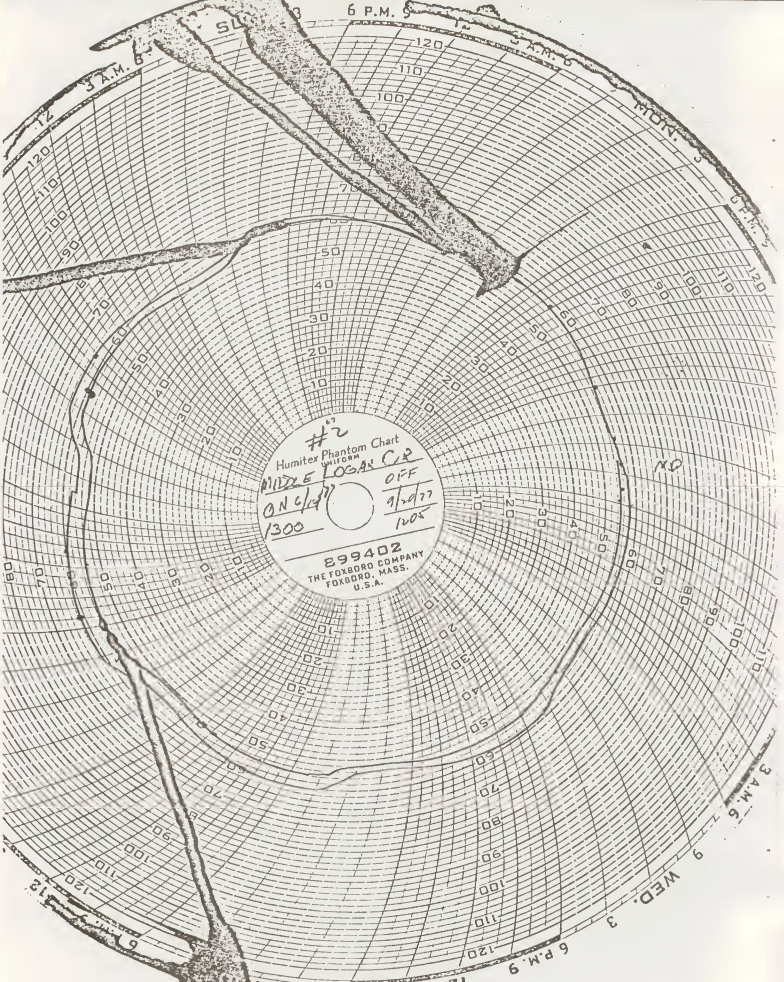

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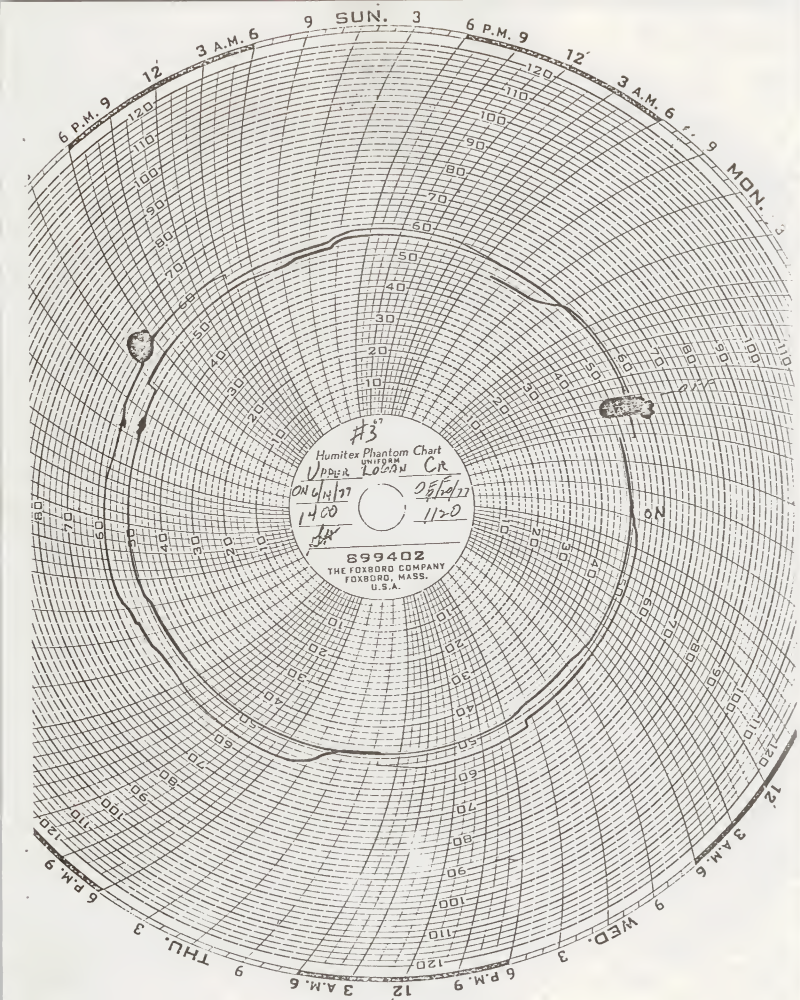

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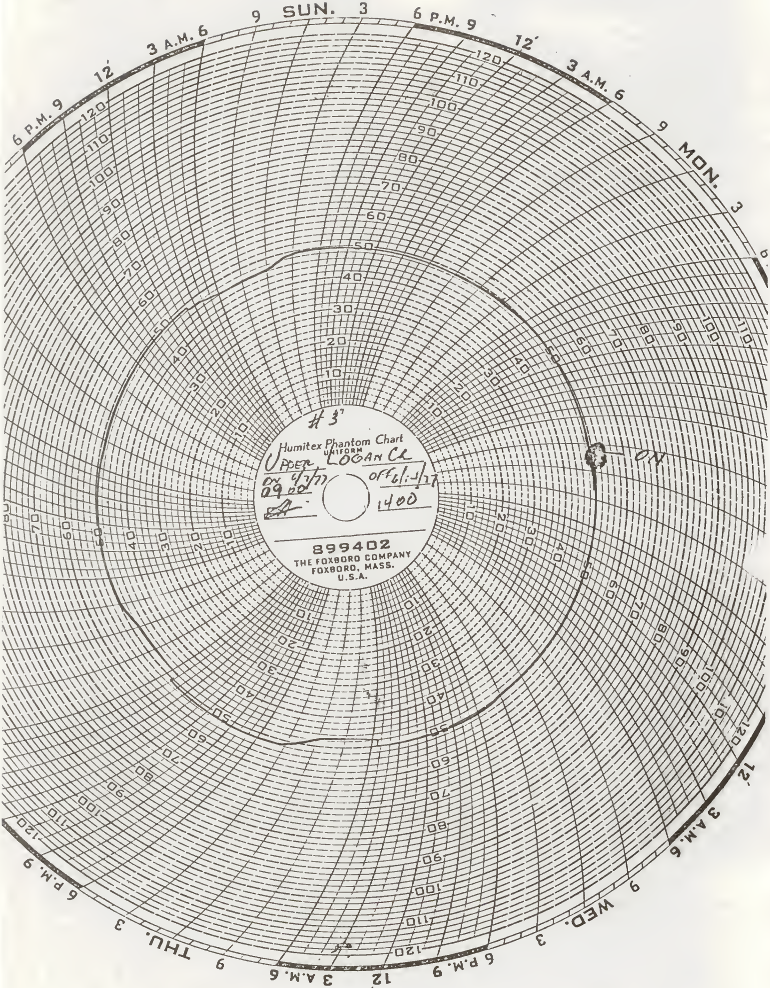

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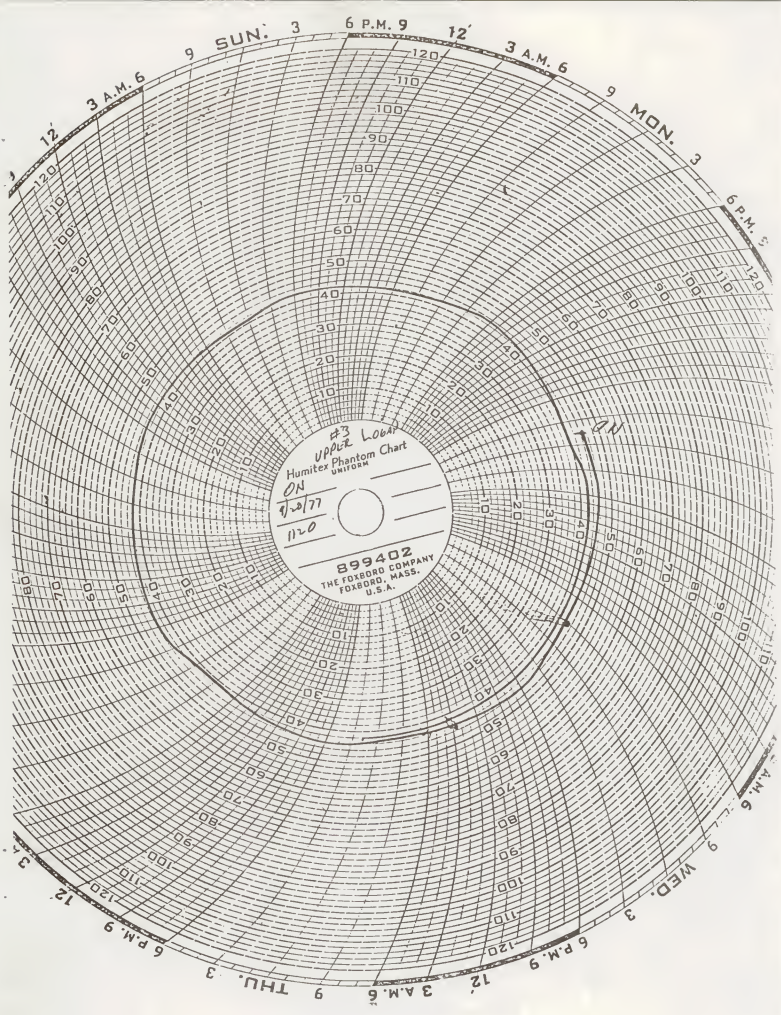

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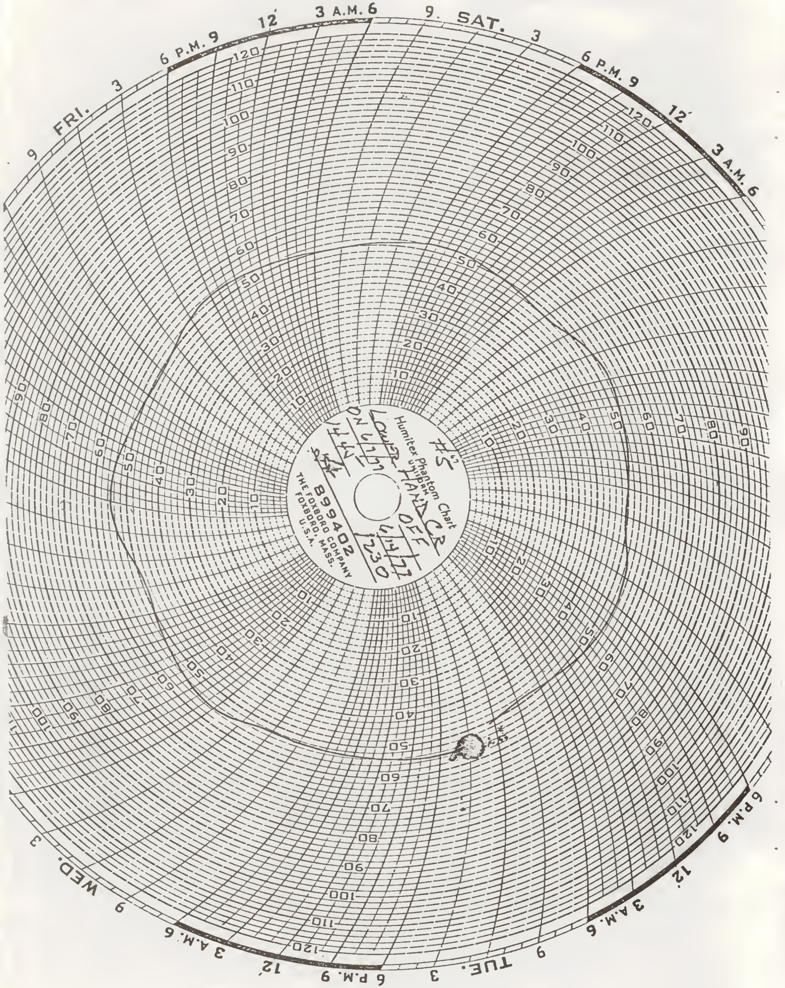

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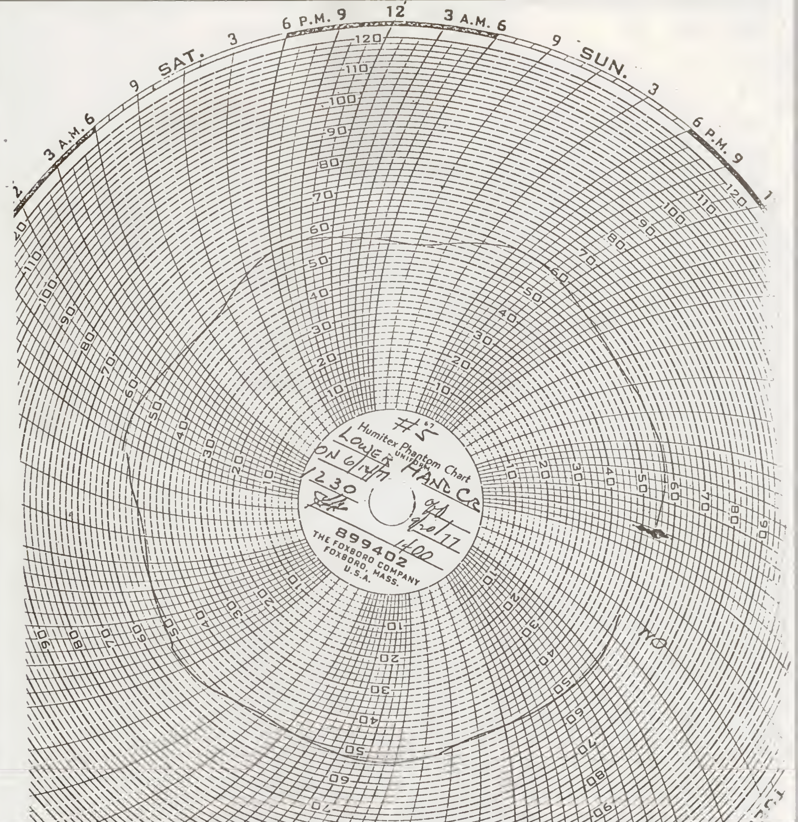
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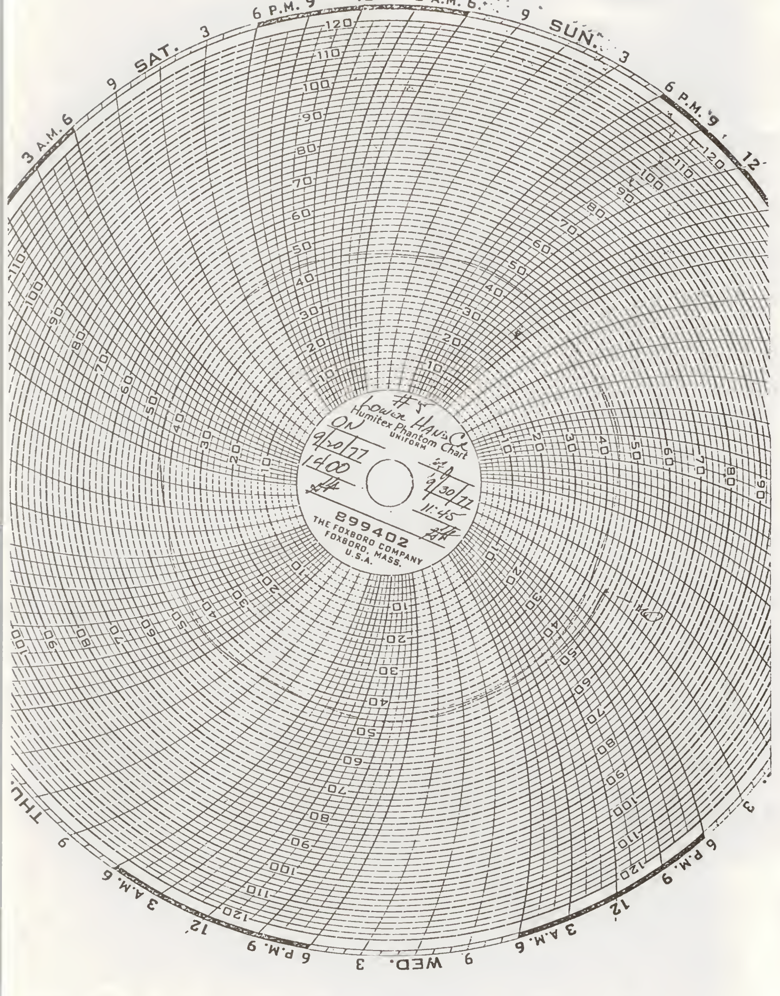
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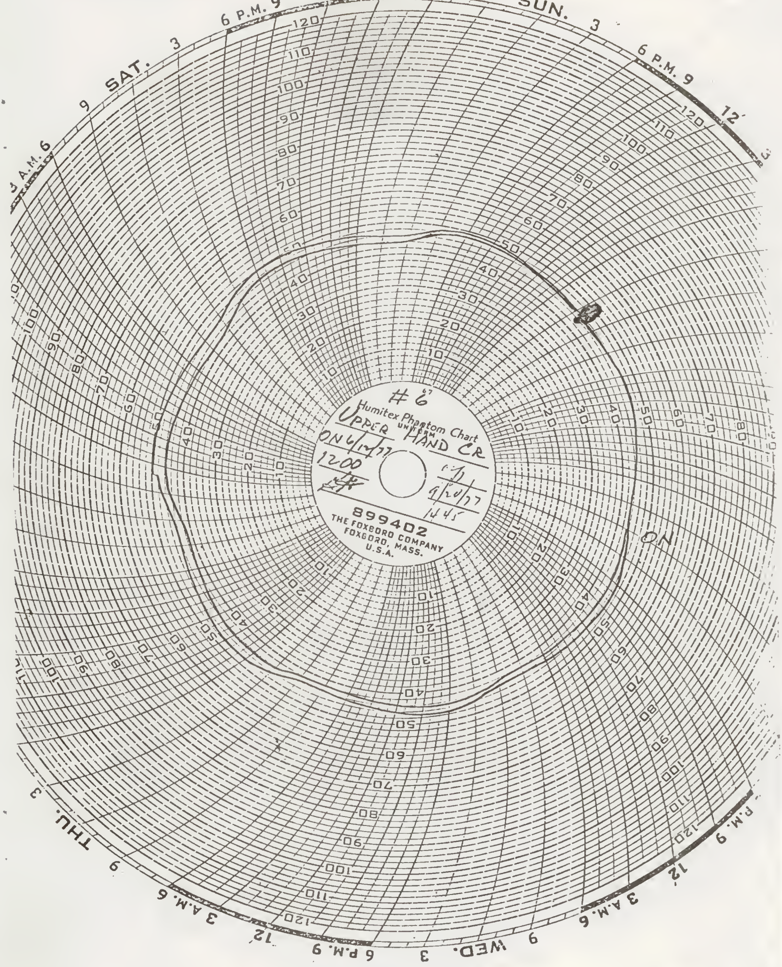

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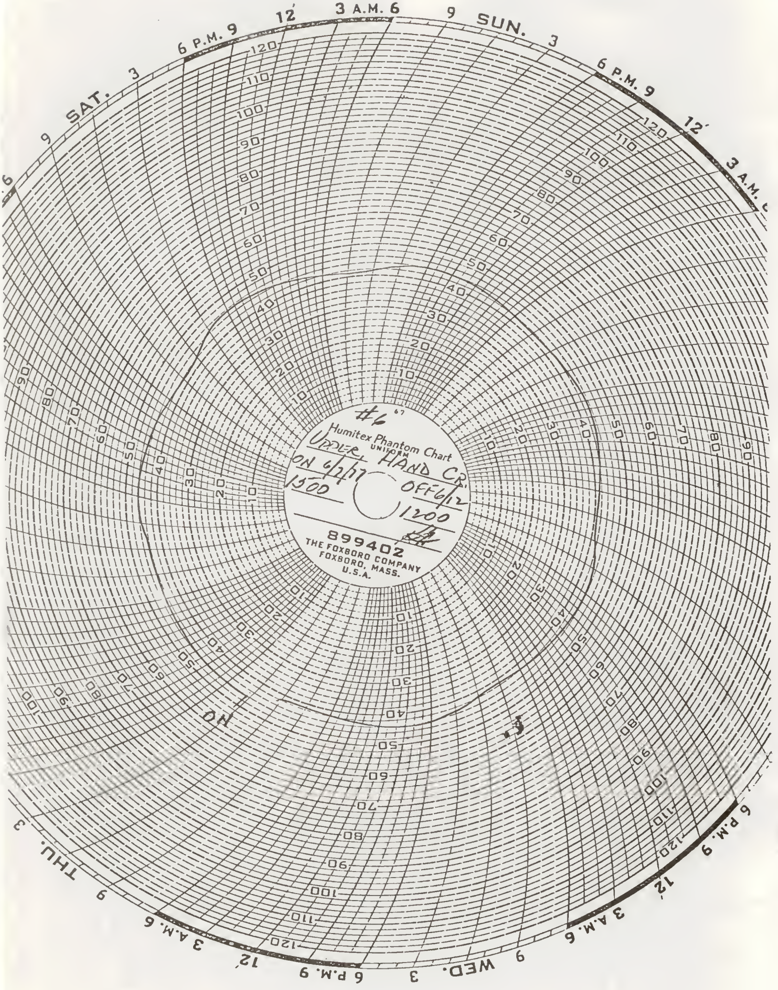
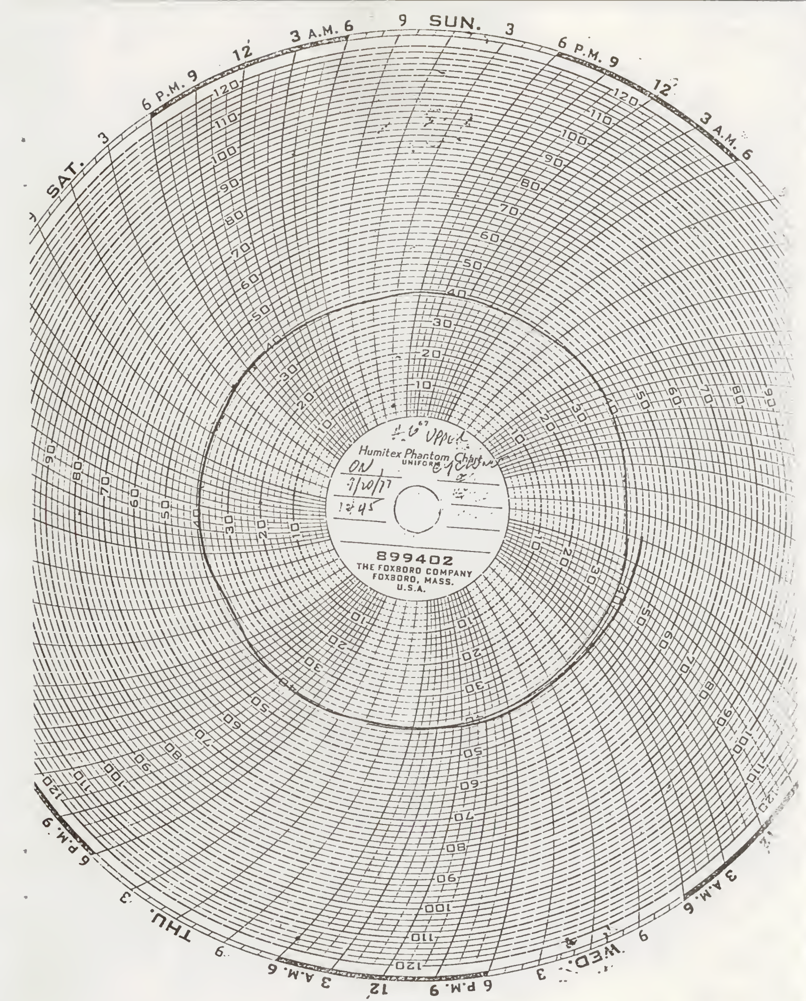
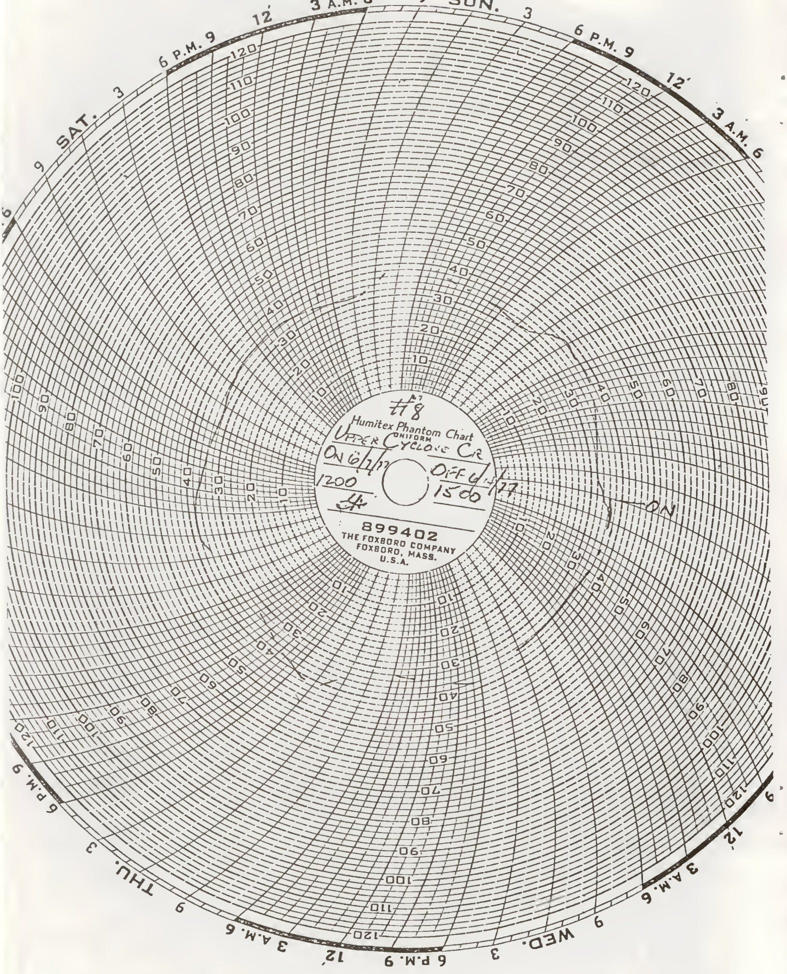
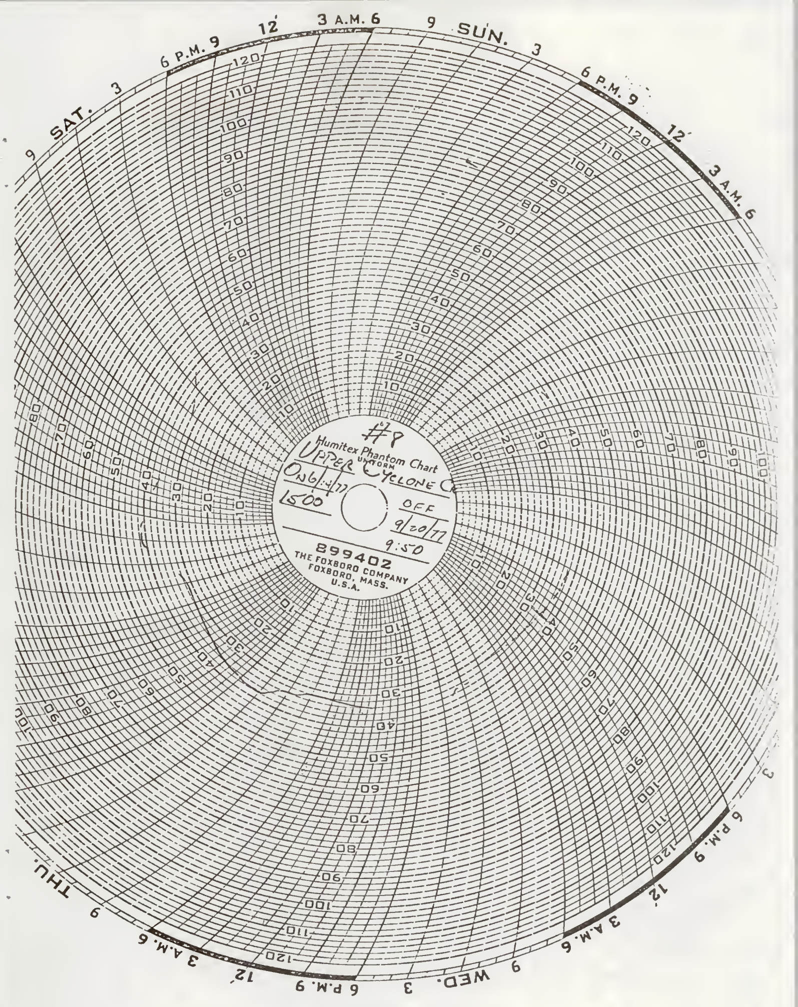


#6
Humitex Phantom Chart
UNIFORM
UPPER, HAND CR.
ON 6/2/77
1500
OFF 6/12
1200
899402
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
SAT.
SUN.
WED.
THU.
ON

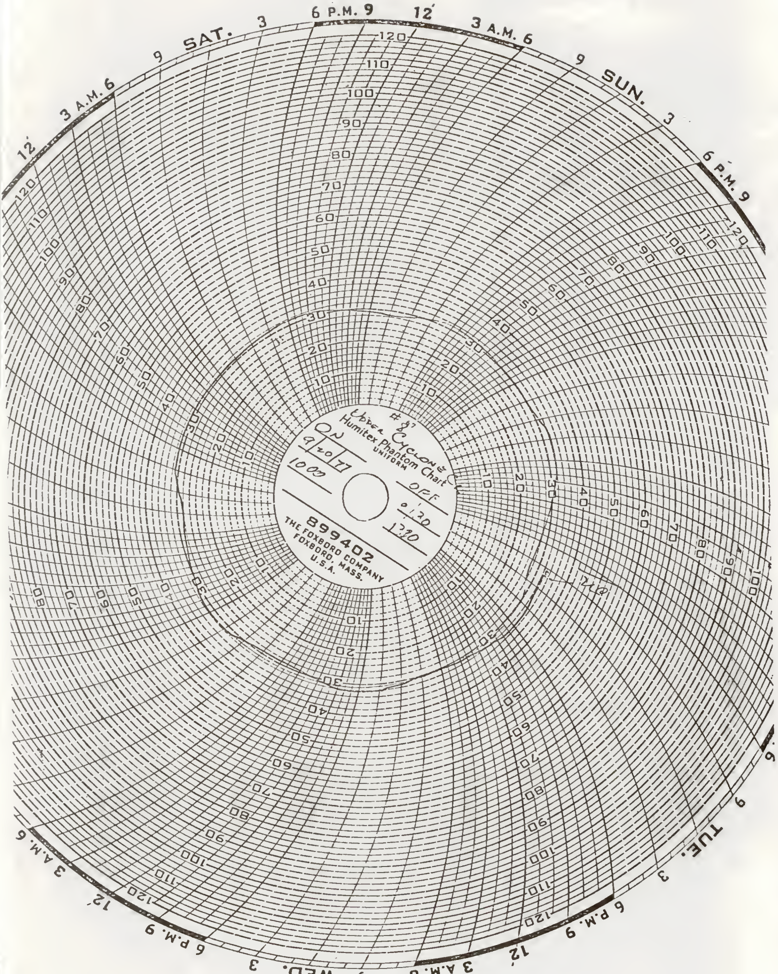

Humitex Phantom Chart
UNIFORM
ON
899402
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
SUN.
SAT.
THU.
WED.



#8
Humitex Phantom Chart
UNIFORM
UPPER CYCLONE CR
ON 6/4/77
1200
OFF 6/4/77
1500
ON
899402
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
SAT.
SUN.
THU.
WED.



#8
Humitex Phantom Chart
UNIFORM
Upper Cyclone C
On 6/14/77
1500
OFF
9/20/77
9:50
899402
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
SAT.
SUN.
WED.
THU.
6 P.M. 9
12
3 A.M. 6



SAT.
SUN.
TUE.
WED.
3 A.M. 6
6 P.M. 9
Upper Cyclone #87
Humitex Phantom Chart
UNIFORM
ON
9/20/77
1003
OFF
9/20
1230
899402
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.

APPENDIX II

METHODS OF ANALYSIS

1. Total Suspended Sediment

Total Suspended Sediment was determined by the gravimetric procedure as described in Section 208D, 14th Edition, "Standard Methods for the Examination of Water and Wastewater", Page 94.

2. Turbidity

Turbidity was determined using a Hach 2100A turbidimeter.

3. Specific Conductivity

Specific Conductivity was determined by means of a Balsbaugh type 100 Wide Range Conductivity Bridge.

4. Laboratory pH

pH was determined with a Corning Model 110 Digital Expanded Scale pH meter with corrections for temperature and slope.

5. Water Temperature

Water temperature was determined by use of Forest Service owned thermographs and was checked at the time of each visit by means of a calibrated hand held thermometer.

6. Organic Color

Organic Color was determined by use of a Hach Model CO-1 Color Comparator reading platinum cobalt units from 0 to 100.

7. Flow Rate

Flows were determined using a direct reading Gurley Pigmy Meter. Stations were selected for uniform flow across regular sections with a minimum of debris or boulders. Lateral spacings varied from 2 feet to 6 inches depending on the size of the stream.

8. Nitrate + Nitrite

This analysis was conducted by the automated Hydrazine Reduction Method.

9. Ortho Phosphate

Ortho phosphate was determined by the Automated Colorometric Ascorbic Acid Reduction Method as described in the EPA "Manual of Methods of Chemical Analysis of Water and Wastes", Page 256ff.

10. Alkalinity

Alkalinity was determined by titration to a colorometric end point with a standard acid as described in Section 403 of the 14th Edition, "Standards Methods for the Analysis of Water and Wastewater", Page 278ff.

11. Bicarbonate

Bicarbonate was determined by calculation based on the alkalinity determinations.

12. Calcium, Magnesium, Total Hardness

EDTA titrations were used to determine calcium and total hardness. Magnesium was calculated as the difference between the two. The procedure is described as Method 313C in the 14th Edition of "Standards for the Analysis of Water and Wastewater", Page 223ff.

13. Sodium

Sodium concentrations were determined using an Atomic Absorption Spectrophotometer.

14. Chloride

Chloride was determined by the Automated Ferrous Cyanide Technique using a Technicon Autoanalyzer.

15. Sulfate

Sulfate concentrations were determined by the Automated Turbidimetric method.

16. Fluoride

Fluoride concentrations were determined by the Alizarin Fluorine Blue method using a Technicon Autoanalyzer.

17. Mercury

Mercury was determined by Cold Vapor method using an Atomic Absorption Spectrophotometer.

18. Arsenic

Arsenic was determined using the Arsine Generation method and an Atomic Absorption Spectrophotometer.

19. Heavy Metals

Heavy metals including iron, manganese, cadmium, lead, nickel, copper and zinc were analyzed by Standard Procedures using Flame Atomic Absorption methodology.